Message

From: Cosler, Doug [Doug.Cosler@TechLawInc.com]
Sent: 5/25/2017 9:47:05 PM
To: d'Almeida, Carolyn K. [dAlmeida.Carolyn@epa.gov]; Dan Pope [DPope@css-inc.com]; 'Jennings, Eleanor' [Eleanor.Jennings@parsons.com]; Bo Stewart [Bo@praxis-enviro.com]; Davis, Eva [Davis.Eva@epa.gov]; Brasaemle, Karla [Karla.Brasaemle@TechLawInc.com]; Wayne Miller [Miller.Wayne@azdeq.gov]
Subject: RE: Modeling of Downgradient Benzene Transport

Table C-2 in Bo's final modeling memorandum shows that with near-boiling conditions (90 deg C) the mole-fraction solubility of benzene in groundwater would about double (to 12 mg/L) from the ambient temp. (25 deg C) value that I used for the 1D transport model benzene starting (start of EBR) concentration (6 mg/L, as shown in the figures).

If the source-zone concentration for benzene was actually 12 mg/L instead of the 6 mg/L value I used for the entire modeling period then all concentrations in Figures 1-4 (1D model results) would double (the 1D model is linear). Looking at Figure 2, however, the downgradient extent of groundwater exceeding the 0.005 MCL would only increase from 0.5 to 0.6 miles. But that estimated effect is much more than you would actually see because the time period for near-boiling temperatures (the SEE treatment time plus a few following months) is a small fraction of the 100-year EBR remediation time frame I modeled (and the gw temperatures were ambient during the 50-yr pre-EBR period also modeled).

From: d'Almeida, Carolyn K. [mailto:dAlmeida.Carolyn@epa.gov]
Sent: Thursday, May 25, 2017 5:15 PM
To: Dan Pope <DPope@css-inc.com>; Cosler, Doug <Doug.Cosler@TechLawInc.com>; 'Jennings, Eleanor' <Eleanor.Jennings@parsons.com>; Bo Stewart <Bo@praxis-enviro.com>; Davis, Eva <Davis.Eva@epa.gov>; Brasaemle, Karla <Karla.Brasaemle@TechLawInc.com>; Wayne Miller <Miller.Wayne@azdeq.gov>
Subject: RE: Modeling of Downgradient Benzene Transport

What about effect of near boiling temps on viscosity and mobility is that not dramatically different conditions?

Carolyn d'Almeida
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"Because a waste is a terrible thing to mind..."

From: Dan Pope [mailto:DPope@css-inc.com]
Sent: Thursday, May 25, 2017 10:56 AM
To: Cosler, Doug <Doug.Cosler@TechLawInc.com>; 'Jennings, Eleanor' <Eleanor.Jennings@parsons.com>; Bo Stewart <Bo@praxis-enviro.com>; d'Almeida, Carolyn K. <dAlmeida.Carolyn@epa.gov>; Davis, Eva <Davis.Eva@epa.gov>; Brasaemle, Karla <Karla.Brasaemle@TechLawInc.com>; Wayne Miller <Miller.Wayne@azdeq.gov>
Subject: RE: Modeling of Downgradient Benzene Transport

Seems reasonable at a quick glance. As Eva indicated the other day, benzene hasn't gotten very far (as far as we know, anyway) to date, so it couldn't be traveling very fast/far in the future unless something has changed dramatically.

From: Cosler, Doug [mailto:Doug.Cosler@TechLawInc.com]
Sent: Thursday, May 25, 2017 12:46 PM
To: 'Jennings, Eleanor'; Bo Stewart; Dan Pope; d'Almeida, Carolyn K.; Davis, Eva; Brasaemle, Karla; Wayne Miller
Subject: Modeling of Downgradient Benzene Transport

Attached (Word .doc) are some figures showing modeled benzene concentrations in the UWBZ downgradient from the site for different biodegradation rates. The model is one-dimensional and can be considered a maximum centerline concentration for an actual 2D or 3D plume. In "real life" horizontal and vertical transverse dispersion would lower these concentrations. Further, the 1D model results do not mean that the plan-view trajectory of a hydrocarbon plume starting at ST012 would actually reach a specific downgradient location (e.g., municipal well field); the 1D analyses simply allow evaluation of average trends with distance. The attached .pdf is the source of the analytical solutions for one-dimensional transport that I used (I combined Eqs. C13 & C5 and solved them with a custom FORTRAN code; refer to Appendix A in the Word .doc).

The model uses a 0.3 feet/day groundwater pore velocity (same as in Bo's modeling) for the UWBZ, which appears to be conservatively high based on AMEC's modeling and site data. The longitudinal dispersivity is 100 feet in the model (based on field tracer studies on this scale), and the effective porosity is 0.3. In addition to first-order biodegradation, I incorporated an assumed 50-yr period of constant source strength (i.e., time period of jet fuel release until the present time) and a 100-yr EBR remediation period (following the initial 50-yr period). Benzene source concentration reductions associated with the 100-yr EBR are represented by a first-order, decaying LNAPL source strength. The chemical retardation factor was 1.5, based on an organic carbon content, foc, of 0.001.

Figure 1 shows that, assuming the groundwater velocity does not change with distance, it would take a "long time" to reach well fields 3-5 miles away (i.e., ~200 yrs or more) even if no biodegradation would occur (i.e., advection and longitudinal dispersion are the only transport mechanisms).

Figures 2-4 are estimated maximum benzene concentrations vs. distance for 3 different first-order biodegradation rates (degradation can be due to any combination of electron acceptors): "median" (Bo's memo Table 10, which are the TOR estimates sent to AF), "low", and "high". Note that the "high" rate is not unusual for a BTEX plume and that the "low" bio rate (5-yr half-life") is very slow in most cases for degradation of a BTEX plume. Figure 2 suggests that benzene concentrations would fall below MCL levels within a distance of about ½ mile from the site for a constant "median" bio rate with a 790-day half-life. Even if the bio rate was, for some reason, very low downgradient from the site the maximum extent of benzene MCL exceedances would only be about 1 mile (Figure 3). It is also possible that the extent of the benzene plume could be very small (< 500 feet +/-) if the bio half-life is ~ 80 days (Figure 4).

From: Jennings, Eleanor [mailto:Eleanor.Jennings@parsons.com]
Sent: Wednesday, May 24, 2017 4:43 PM
To: Bo Stewart <Bo@praxis-enviro.com>; Dan Pope <DPope@css-inc.com>; d'Almeida, Carolyn K. <dAlmeida.Carolyn@epa.gov>; Cosler, Doug <Doug.Cosler@TechLawInc.com>; Davis, Eva <Davis.Eva@epa.gov>; Brasaemle, Karla <Karla.Brasaemle@TechLawInc.com>; Wayne Miller <Miller.Wayne@azdeq.gov>
Subject: EBR Checklist, Version 3

Good evening/afternoon, All,

Attached is the EBR checklist for you all to look over and comment on. In case somebody has not done Track Changes in Excel (I don't know too many who have), the first worksheet includes some instructions I wrote out to make it easy to do.

Thanks,
Eleanor

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"Safety Isn't Expensive. It's Priceless."